Acknowledge Receipt Message

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RadNet Acknowledge Receipt Message
Thursday, February 19, 2004

Acknowledge Receipt Message

The purpose of the Acknowledge Receipt (AR) message is to allow a monitoring computer to acknowledge the receipt of data from an instrument. This message is optional and may not be supported by the instrument manufacture. However, if the RadNet system needs assurance that a monitoring computer has received the data from the instrument it would utilize this message. The following provides the basic guidelines for AR message use.

Note: A monitoring computer could be a laptop, tablet PC, cell phone, Pager or PDA.

1. Upon receipt of the data packet, the monitoring computer would send the AR message back to instrument.

2. If the instrument has to send data in several packets (eg. 4 packets), then the monitoring computer must receive all packets (in this case 1 through 4) before the receiving computer sends the AR message.

3. The monitoring computer should do a directed response so that no other computer/instrument would receive the AR message.

4. Most RadNet Instruments and Transport Protocol Converters (TPC's) contain a host list of destinations. A host list typically contains the IP address of a receiving computer (e.g. 172.17.1.1 for directed or 172.17.1.255 for a broadcast), the type of protocol to use (TCP or UDP), and the port number to use (Transmit = 16367, Receive = 16368, or a single port number). An additional Boolean field, called "acknowledgement", is required to support the AR message. The field would be set to true if the instrument expects an AR message from the monitoring computer (i.e. from an IP address contained within the host list).

5. It is not desirable to have every computer on the network responding with AR messages because such activity could cause a serious impact on the network bandwidth usage. The AR message is intended for use by critical monitoring computers. For example, a computer that is capturing the data into a database, Programmable Logic Controller (PLC), or emailing notices. Furthermore, not all computers would be capable of sending an AR message. A typical end user monitoring computer would not provide this support. However, a server may need to acknowledge the receipt of data from critical instruments. By controlling the software interface, the instrument can still broadcast (push) data to a subnet with only the servers sending AR messages. It may be useful to think of AR messages in at least two situations. One would be for attempting to verify delivery of data on a "best effort" basis and another where archival of data is absolutely required. As discussed in 4., the byte set aside for this can be used to indicate which mode is desired. If "best effort" is what's required, then the instrument can attempt to send the data a certain number of times and let the effort go and try again at the normal RadNet interval. If archival is required then the data can be stored, as discussed below. It was considered to use an indicator in RadNet messages, in general, when AR messages were required. But this ignores the problem of returning the AR message in a non-local LAN where addressing from the originator can be lost if any aliasing methodologies are used.

6. If the instrument does not receive an AR message, it can take several steps to determine what could be wrong:
   a. Retransmit the data a given number of times (3). The retransmission must use timing values that make sense with the operation of the instrument. This is best accomplished by using the normal or alarm RadNet times as maximums for time between AR messages and number of attempts. If the attempts go beyond these limits and new data becomes available, the instrument manufacturer may decide to ship the new data and look for AR messages.
   b. The instrument may try to PING the Host List IP Address that is on its own subnet. If the instrument receives no response, then the network card could be malfunctioning, network cord has become unplugged, the switch or hub is down, or the OS has a problem.
   c. PING the gateway (the router), if the instrument has a gateway field filled in. If the instrument receives no response, then the router could be down.
   d. PING the computer(s) across the router. If the instrument receives no response then that subnet could be down.

   Note: If the data is critical then it may be important to consider storage of the data locally (hard disk, flash card, ScanDisk, memory, Etc). When the network is down, the instrument can archive the RadNet message at the appropriate push rate to media (internal/local storage media) contained within the instrument.

Note: A little known fact is that any computer on a subnet can be PINGed by setting an IP octet to 255. In order to PING computers on a class C subnet it is necessary to use an IP address of 172.17.1.255; a class B subnet would use 172.17.255.255. Any computer on the network can respond to the PING.

7. If this message is utilized, then dual ports should be used (transmit and receive).

8. At no time should an instrument stop pushing data at its normal/abnormal push rates or upon a state change while waiting for an AR message.

This RadNet message should be used instead of TCP. For every TCP/IP message, UDP/IP can ship 6 messages because of the TCP overhead and protocol requirements. In most cases when the AR message is used, for every TCP/IP message, UDP/IP would only require 2 network packets. One packet to transmit the data from the instrument and one packet to acknowledge the receipt of the data by the monitoring computer. This can significantly reduce network bandwidth usage. This is not a problem with a small instrument network. However, with high data rates or large installations, this becomes a very important fact.

The instrument/PC/Interface Hardware/ Translation Protocol Converter (*TPC) must be capable of handling the RadNet Update/Request Date/Time message. This can be done using the following methods:

a. The receiving computer/TPC translates the RadNet Update/Request Date/Time message into the instrument's native code and sends this code to the instrument. Such as a computer connected to instrument using RS-232/485. It is the responsibility of the receiving unit to complete the task outline below.

b. The receiving unit sends the RadNet Message to the instrument and the instrument processes the RadNet message. This approach would require the instrument be capable of understanding RadNet messages in serial format. The instrument would only need to look at byte 3 of the message to determine what type of message it has received. Such as a TPC connected to an instrument. The TPC received the RadNet message form the network, it then passes the datagram portion of the packet to the serial port. The TPC does no translations of its own and does not check what the data stream contains (it up to the instrument to provide this support), it would pass the data stream onto the connected RS-232/485 instrument. It is the responsibility of the instrument to complete the tasks outline below.

c. The instrument does not support this option; in this case the receiving unit ignores the RadNet message. This may be done because of security reasons. The instrument would only push data onto the network because the end user does not want the instrument to accept any commands from the network. If this is done to meet security concerns, it maybe appropriate to remove the receive wire from the serial connection. This way, you would be assured that no data could get to the instrument. Because the message is ignored, the device would not perform the tasks outlined below.

*** A TPC is an embedded device that converts RS-232/485 to Ethernet or Wireless using TCP/IP or UDP/IP. Their purpose is to take a serial communication data stream and place it into the datagram section of the protocol (See TCP/IP or UDP/IP RFC for more information) and forward it across the network. They also are capable of receiving data streams from the network and passing the data to a RS-232/485 instrument. Some examples of these devices are the Aquila RadComm, Lantronic MSS-1, Eberline TPC, etc.**

CAUTION:

If the monitoring computer and/or the instrument uses the same port (such as 16367) to send or receive data at a high push rate (instrument .1 second push rate), then data loss can occur. A .1 second normal push rate only allows for a very small window of opportunity to gain access to the instrument. Most instruments are simple 8 or 16 bits processor-based, incapable of spawning threads to handle multiple requests from the network.

Subsequently the network will be impacted because of network error messages. The error message generated by the network will say “destination port unreachable”. This error message is saying that the port is being used at the same time access is being requested. The logical course of action would seem to be to increase the push /requests rates. This approach, however, will only increase the network problem and could even bring the network down. Instead, it is appropriate to decrease the push/request rate. Increasing or using very high push rates is only appropriate when full knowledge of the network/instrument capacity is known and its affects are understood.

It is important to remember that the major limiting factor for RadNet is finite value of network bandwidth. Every message and every computer/instrument has an effect on the network and its available bandwidth. Therefore, every user, every computer and every instrument must utilize the network effectively. If RadNet has it own network infrastructure (Intranet), then there is also total control over the network and bandwidth usage. However, if RadNet is running on top or within existing infrastructure and/or connecting to the Internet, then network usage becomes important. As the network usage (bandwidth usage) increases, so does the number of collisions on the network that can lead to a network failure. If the RadNet normal/abnormal push rate is once every 5 minute(s), then there is plenty of open space (time) for a request to get through to the instrument.

Just because data can be pushed at .1 second and the network can handle it, doesn't mean it should. The push rate of the data should be based upon the instrument having valid data, how smart the instrument is, and its effect on the network during an event. It is necessary to allow enough bandwidth so that all of the instrument(s) can push at the abnormal push rates with network bandwidth to spare (<= 50% of the network bandwidth). RadNet makes use of the fact that instruments have become smarter and can detect when and if they have a problem. This important fact should also be used to determine the push rate of an instrument. The RadNet system should be tuned (push rates adjusted) to make sure there is plenty of reserved network bandwidth for an event (all instruments go into abnormal push rates). This scenario should be tested before going into production.

One way to prevent the bandwidth problem is to use two UDP ports for the network interface. Instruments can use port 16367 to send data and 16368 to receive requests. The monitoring computer can use port 16367 to receive data and port 16368 to transmit commands or requests. This distribution allows the instruments to continue to push data at high rates and still be able to receive request at the same time.

Instrument manufacturers can support the two-port option by being able to set the send/receive port parameters. If both parameters are set to 16367, then the instrument can only use one UDP port send/receive data. However, if the send parameter is set to 16367 (send/push data port) and the receive port is set 16368 (listen port) the instrument then requires two parameters. For a more secure interface, the listen port should only allow a certain IP address to pass requests. The instrument should check the incoming requests against it list of IP addresses (MAC addresses can also be used). If the requesting IP address is not on this IP list, then the instrument can ignore the request. This technique is called IP filtering and is a common practice in the network world. To secure the instrument further, the listen option should also be selectable. Selectable means that the instrument will not allow anyone to gain access (request or send commands) to it and will only transmit data to the network. This option is valuable to any instrument that is not behind a secure firewall.

Field Name	Type	Position	Codes	Notes
Header Check Sum	Byte	1		The first byte (01, byte) is a check sum, to ensure the integrity of the header transmission. The check sum is the sum of bytes 2 through 5 depending on message type. The vendor is responsible for determining how this value is to be used.
RadNet Version Number	Byte	2	See RadNet Versions Page	The second byte (02, byte) is the RadNet version number. This number is used to indicate the version of the RadNet message.

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				The receiving software is responsible for handling all received RadNet messages, although the most current version's functionality may not be provided.
Message Codes	Byte	3	See RadNet Message Codes Page	Byte (03) is the message code. The message code tells what type of RadNet message has been sent (status, check source, etc.). Value = 7, Acknowledge Receipt
Monitor Type	Word	4-5	See RadNet Monitor Type Codes Page	Bytes (4-5) are a code for the instrument type.

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Example of Acknowledge Receipt Message Format:

The following is an example of how to send the acknowledge receipt to an instrument.

RadNet Field	Start Byte Position	End Byte Position	Notes
Start Of RadNet Header			
Header Check Sum	1	1	The check sum is calculated using byte 2 to 5
RadNet Version	2	2	Value = 0
Message Code	3	3	Value = 9, Acknowledge Receipt
Monitor Type	4	5	Value = 0 Gamma Area Monitor
End Of RadNet Header			

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Authentication Status Codes

See the following pages for more information concerning RadNet Security Implementation:

Background Information
RadNet Security Implementation
Authentication
Encryption

These codes indicate whether a RadNet message has been authenticated (message fails signature verification). RadNet message(s) are directed to/at a RadNet Authentication Server (RAS) or other device. The RAS will authenticate the message and set byte 52 to indicate the status of the authentication process. The RAS server will then forward the message to clients on the network. It is important that the RAS server is secure and that the data leaving the RAS server is on a secure network (the message will not be tampered with after authenticated). It is also important to note that the RAS server does not strip the authentication keys from the message, and the authentication process could be done at any time, including storing the authentication signature within a database for future verification of the message.

The Authentication software/server will set this byte value to indicated message signature verification status.

Code	Meaning	Notes
0	Message is Ok	
>0	Message fails signature verification.	

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RadNet Channel Types

Below is a code for type of channel.

Code	Meaning	Notes
0	Alpha	
1	Beta	
2	Gamma	
3	Neutron	
4	Iodine	
5	Noble Gas	
6	Tritium	
7	Stack Flow	
8	Sample Flow	
9	Temperature	
10	Sample Pressure	
11	Leak rate	Primary to secondary, or containment building leak
12	Reactor power	Used for leak measurements
13	Beta + Gamma	The sum of the beta and gamma channels.
14	Latitude	
15	Longitude	
16	Altitude	
17	Humidity	
18	Wind Speed	
19	Wind Direction	
20	Alpha/Beta	
21	Pulse Height Analysis (PHA)	
22	Dust Particle	
23	Humidity	
24	Anemometer	

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RadNet Monitor Type Codes

Bytes (54-55) are code for the instrument type.

Code	Meaning	Notes
0	Gamma Area Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
1	Gamma Crit Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
2	Neutron Area Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
3	Neutron Crit Monitor	Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information.
4	Alpha CAM	Uses the Alpha CAM body, Measurement Footer, Spectrum Footer. See Alpha CAM Header, Body, Measurement Footer, Spectrum Footer and Notes for more information.
5	Beta CAM	Uses the Beta Cam body and footer format. See Beta CAM Header, Body, Footer and Notes for more information.
6	PCM Monitor	Uses the PCM body and footer format. See PCM Header, Body, Footer and Notes for more information.
7	PCM Portal Monitor	Uses the PCM Body and Footer format. See Portal Header, Body, Footer and Notes for more information.
8	PING	Uses the PING Body and Footer format. See PING Header, Body, Footer and Notes for more information.
9	Glove Box Monitor/Hand Monitor	Uses The PCM Body and Footer format. See PCM Header, Body, Footer and Notes for more information.

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10	Hand And Foot Monitor	Uses The PCM Body and Footer format. See Hand and Foot Header, Body, Footer and Notes for more information.
11	Generic Sensor	Uses The Generic Sensor Body and Footer format. See Generic Sensor Header, Body, Footer and Notes for more information.
12	Electronic Reading Dissymmetry	See Header, ERD Body, ERD Footer, for more information.
13	Item Contamination Monitor (ICM)	Uses The ICM Body and Footer format. See Header, Body, Footer and Notes for more information.
14	Radiation Gateway Monitor	Uses The Radiation Gateway Body and Footer format. See Header, Body, Footer and Notes for more information.
15	Gamma Spectrum	Uses The Gamma Spectrum Body, Measurement, Spectrum, Status and Footer format. See Header, Body, Measurement, Spectrum, Status and Notes for more information.
16	Portable Instruments	Protocol Pending, in development by vendor
17	Meteorology Tower	Uses The Meteorology Tower Body and Footer format. See Header, Body, Measurement, Status, and Notes for more information.
18	Video	Uses The Video Body, Status and Footer format. See Header, Body, Footer, Status and Notes for more information.
19	Image	Protocol Pending, in development by vendor
20	Audio	Protocol Pending, in development by vendor
21	Security data tag/seal	Protocol Pending, in development by vendor
22	Tritium Air Monitor	Protocol Pending, in development by vendor
23	Dust Particle Monitor	Protocol Pending, in development by vendor

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RadNet Message Codes

Byte (03) is the message code. The message code indicates what type of RadNet message has been sent (status, check source, etc.).

Code	Meaning	Notes
0	Normal/Standard RadNet Message	Message is pushed by the instrument and received by the clients.
1	Alarm Ack	Message is pushed by the clients and received by the instruments. See Alarm Acknowledge Alarm Msg. Notes and Alarm Acknowledge Header Format
2	Pass Through	Message is pushed by the instrument and received by the client or can be pushed by the client and received by the instrument. This method can be used for bi-directional communication by the clients and instruments. See Pass Through Msg. Header Notes / Pass Through Header Format or Pass Through Codes
3	Check Source	Message is pushed by the clients and received by the instruments. See Check Source Msg. Notes and Check Source Header Format
4	Diagnostic/Self-Check	Message is pushed by the clients and received by the instruments. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format
5	Request Data	A client/server sends this request to an instrument. In response to this request the instrument will send its current information (Normal RadNet Message). See Request Data Notes and Request Data Header Format
6	Update/Request Date/Time	A client/server sends this request to an instrument. In response to this request the instrument will send/set the date/time. See Update/Request Date/Time Notes and Update/Request Date/Time Header Format
7	Acknowledge Receipt	This message is used by the monitoring computer to acknowledge receipt of data from an instrument. See Acknowledge Receipt Message Header Format and Acknowledge Receipt Message Notes for more information.
255 (FFh)	Encrypted RadNet Message	See the following pages for more information: Background Information RadNet Implementation

		Encryption Header Message Format Encryption Background Information

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RadNet Operational and Hardware Status Codes

Note: It is the responsibility of the instrument manufacturer to prioritize the operational and hardware status for the instrument. Any status code can be used either as an operational or hardware status code base upon the instrument usage or needs.

Below is a code used to display the Hardware/Operational Status of the instrument. Hardware status is intended to be a troubleshooting guide when responding to an abnormal condition. Instrument hardware malfunctions generally require repair work. Other conditions may be attributed to either hardware or operational problems. Instrument vendors are responsible for classifying conditions and prioritizing the status change. The intention is that only the most critical status change be pushed; however a series of messages based upon a list of status changes could also be pushed. For example: If the instrument detected failures with low voltage and low background, the vendor could push each status in a separate message (at the abnormal push rate). These statuses could then be interpreted by the client as an HV power supply failure.

OP = Guide For Operational Status Use

HW = Guide For Hardware Status Use

Code	Meaning	OP	HW	Notes
0	Normal	Y	Y	
1	High Alarm	Y	N	
2	HV Fail	N	Y	
3	Count Fail	Y	N	
4	Bkg Fail	Y	N	
5	Bkg Update	Y	N	
6	Comm Fail	N	Y	
7	Gas Empty	Y	N	
8	Buffer Full	Y	Y	
9	Acked High Alarm	Y	N	
10	Flow Fail Low	Y	Y	
11	Flow Fail High	Y	Y	
12	Filter Door Open	Y	N	
13	Instrument Not Ready	Y	Y	
14	Instrument In Calibration Mode	Y	Y	
15	Fast Concentration Alarm	Y	N	
16	Slow Concentration Alarm	Y	N	
17	DAC Hours Alarm	Y	N	

18	Count Rate Alarm	Y	Y	
19	Release Rate Alarm	Y	N	
20	Fast Concentration Alarm Disabled	Y	N	
21	Slow Concentration Alarm Disabled	Y	N	
22	Count Rate Alarm Disabled	Y	N	
23	Check Source Mode	Y	N	
24	Out Of Service	Y	Y	
25	Alert Alarm	Y	N	
26	Trend Alarm	Y	N	
27	Not Initialized	Y	Y	
28	Standby	Y	Y	
29	Local Control	Y	Y	
30	Flush	Y	N	
31	Alarm Disabled	Y	N	
32	External Fail	Y	Y	
33	AC Off	Y	Y	
34	Crit Relay Fail	Y	Y	
35	Out Of Limits	Y	Y	
36	Crit Alarm	Y	N	
37	NV RAM Fail	N	Y	When the instrument's non-volatile RAM cannot be read/written.
38	Check Source Results	N	Y	Indicates that the message with this status carries check source results. This indicates that this message contains the final check source result at the completion of the check source integration. Prior to this code being sent the status code would be 23 (*Check Source Mode*).
39	Audio Failure	N	Y	Indicates that the instrument has a problem with its audio circuit.
40	Over Range	Y	Y	Indicates that the instrument has exceeded an Over Range value.
41	Diagnostic/Self-check completed, Passed self-check	Y	Y	Indicates that the instrument has performed an Internal Diagnostic/Self-check and found no error conditions. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format

42	Diagnostic/Self-check completed, Failed self-check	Y	Y	Indicates that the instrument has performed an Internal Diagnostic/Self-check and found error conditions. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format
43	High/High Alarm	Y	N	Third alarm level used in many plants.
44	Internal stabilization failure	Y	N	From automatic energy stabilization.
45	Parameter error	Y	N	Bad setup.
46	Temperature failure	N	Y	Temperature out of operational range.
47	Power supply failure	N	Y	From power supply, or from voltage reading.
48	Analog input failure	N	Y	4-20 mA analog input failure (0 mA for example).
49	Filter failure	N	Y	Automatic filter advance failure (motor, end of roll…).
50	Detector cable failure	N	Y	
51	Electronic or Acquisition board failure	N	Y	Electronic failure.
52	Low Battery	N	Y	Backup battery or internal battery has a low voltage condition.
53	Battery Failed	N	Y	Backup battery or internal battery has failed.
54	Clock Failed	N	Y	Internal clock has failed.
55	User defined	Y	Y	This error code is used whenever an instrument supports user defined error codes. It is used whenever there is a desire to inform a user that one of their error conditions has been reached. Since there is no way of knowing what is contained in the error code logic, this generic response should be used to indicate the error.
56	Internal Communication Failure	N	Y	

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RadNet Versions

Note: The last approved version in this list is the current version in use by RadNet.

The second byte (02, byte) is the RadNet version number. This number is used to indicate the version of RadNet be pushed by the server. It is the responsibility of the receiving software to handle all received RadNet messages, although the most current version's functionality may not be provided.

Version	Date Approved	Notes
0	Approved	

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RadNet Units Codes

Below is a code for the RadNet units of the reading.

Code	Meaning	Notes
0	cps	
1	Rem/hr	
2	R/hr	
3	Sv/hr	
4	Bq/cm3	
5	Bq	
6	Degrees Centigrade (C)	Temperature Unit
7	Pascal (Pa)	Pressure Unit
8	cc	Flow Volume Unit
9	cc/sec	Flow Rate Unit
10	cps/cc	Activity Unit
11	counts	Counting Events Unit
12	cm/sec	Velocity Unit
13	bqMeV/cc	Gamma Gas Activity
14	degrees	Wind Direction (180 = south)
15	Gy/hr	Dose Rate Unit
16	RPU%	Reactor Power Unit
17	Kg/sec	Masse flow rate
18	n/cm2	Neutrons / cm2
19	n/cm3	Neutrons / cm3
20	DAC	Derived Air Concentration
21	bq/m3	Becquerel per cubic meter
22	bq/kg	Becquerel per kilogram
23	Latitude	
24	Longitude	
25	Mu_Hemin	Hemisphere North
26	Mu_Hemis	Hemisphere South
27	Mu_Hemie	Hemisphere East
28	Mu_Hemiw	Hemisphere West
29	Mu_Knots	Wind Speed (knots)
30	Mu_KPH	Wind Speed (knots per hour)
31	Mu_MPS	Wind Speed (meters per second)
32	Mu_MPH	Wind Speed (meters per hour)

33	Mu_METERS	Altitude (meters)
34	Mu_Feet	Altitude (feet)
35	Mu_Percent	Humidity
36	Resistance	Electrical Resistance
37	µm	Micro-meter

RadNet Server Status Codes

Byte (7) is a code that displays the status of the server. Codes are provided for normal as well as a variety of abnormal conditions. See Appendix A for Server Status message codes.

Code	Meaning	Notes
0	Normal Operation	
1	Instrument Communication Error	
2	TCP Communication Error	
3	UDP Communication Error	
4	Hard Disk Full	
5	Password Fail	
6	Starting Up	
7	Shutting Down	
8	Program Error	
9	NetWork Access Granted	
10	NetWork Access Denied	